AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (currently amended) An optical wavelength division multiplexed signal monitoring apparatus comprising:

optical wavelength division demultiplexing means for carrying out optical wavelength division demultiplexing of an optical wavelength division multiplexed signal including N optical signals with a bit rate f_0 (bits/s), which are wavelength multiplexed, where N is an integer greater than one;

one or N opto-electric conversion means for receiving optical wavelength division demultiplexed signals demultiplexed by said optical wavelength division demultiplexing means, and for converting the optical wavelength division demultiplexed signals into electric intensity modulated signals; ~~and~~

electric signal processing means for carrying out optical signal quality evaluation based on the electric intensity modulated signals output from said one or N opto-electric conversion means; and

sampling clock generating means for generating a sampling clock signal whose repetition frequency is f_1 (Hz) ($f_1 = (n/m)f_0 + a$, where n and m are a natural number, and a is an offset frequency), wherein

said electric signal processing means is a single system, and samples electric intensity modulated signals supplied from said one or N opto-electric conversion means by the sampling clock signal generated by the sampling clock generating means, obtains optical signal intensity distribution from sampled signals generated thereby, and

evaluates an optical signal quality parameter based on the optical signal intensity distribution.

2. (currently amended) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 1, wherein said electric signal processing means has N inputs, stores N channel electric signals supplied from said one or N opto-electric conversion means by N buffers for a predetermined time period, and processes the electric signals by sequentially reading them from said buffers.

3. (currently amended) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 1, wherein said electric signal processing means has N inputs, and processes N channel analog electric signals supplied from said one or N opto-electric conversion means by sequentially reading the analog electric signals by sequentially switching connections with the analog electric signals.

4. (currently amended) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 1, further comprising wavelength selection means ~~disposed before said electric signal processing means for making wavelength selection by wavelength division demultiplexing to reduce a number of inputs to said electric signal processing means to one, wherein said electric signal processing means stores an electric signal supplied from said one opto-electric conversion means by a single buffer for a predetermined time period, and processes the electric signal by reading it from said buffer.~~ for selecting and carrying out optical wavelength division

demultiplexing of any one of channels of the optical wavelength division multiplexed signal consisting of N optical signals with a bit rate f_0 (bits/s), which are wavelength multiplexed, where N is an integer greater than one; and

selection wavelength control means for controlling a wavelength to be selected by said optical wavelength selection means, wherein

said one or N means is a single opto-electric conversion means, and receives one-channel optical wavelength division demultiplexed signal said optical wavelength selection means selects and demultiplexes, and converts it into one-channel electric intensity modulated signal which is processed by said electric signal processing means.

5-37. (canceled)

38. (currently amended) The optical wavelength division multiplexed signal monitoring apparatus as claimed in any one of claims ~~5-37~~ 1-4 or 41-70, wherein said electric signal processing means is disposed in an optical signal receive terminal, and comprises:

a signal-to-noise ratio coefficient measuring section for measuring a signal-to-noise ratio coefficient of an optical signal transmitted on an optical signal route between an optical signal transmit terminal of a first optical node and an optical signal receive terminal of a second optical node;

an initial state storing section for storing an initial signal-to-noise ratio coefficient said signal-to-noise ratio coefficient measuring section measures in a state without any failure at a system installation; and

an optical signal quality evaluating section for comparing the initial signal-to-noise ratio coefficient stored in said initial state storing section with a signal-to-noise ratio coefficient said signal-to-noise ratio coefficient measuring section measures at every predetermined time interval during system operation,

wherein said optical wavelength division multiplexed signal monitoring apparatus carries out analog monitoring independent of an optical signal modulation method, format and bit rate.

39. (currently amended) The optical wavelength division multiplexed signal monitoring apparatus as claimed in any one of claims ~~5-37~~ 1-4 or 41-70, wherein said electric signal processing means is disposed in an optical signal receive terminal, and comprises:

a signal-to-noise ratio coefficient measuring section for measuring a signal-to-noise ratio coefficient of an optical signal transmitted on an optical signal route between an optical signal transmit terminal of a first optical node and an optical signal receive terminal of a second optical node;

an initial state storing section for storing an initial signal-to-noise ratio coefficient said signal-to-noise ratio coefficient measuring section measures in a state without any failure at a system installation; and

an optical signal quality evaluating section for comparing the initial signal-to-noise ratio coefficient stored in said initial state storing section with a signal-to-noise ratio coefficient said signal-to-noise ratio coefficient measuring section measures at every predetermined time interval during system operation, wherein

said signal-to-noise ratio coefficient measuring section comprises:

optical signal intensity distribution measurement means for measuring intensity distribution of the optical signal by sampling intensity of the electric intensity modulated signal at a clock signal frequency f_1 (Hz) ($f_1 = (N/M)f_0 + a$, where N and M are positive numbers, and a is an offset frequency);

signal-to-noise ratio coefficient evaluation means for evaluating the signal-to-noise ratio coefficient using an amplitude histogram obtained from the optical signal intensity distribution within a mean time, and wherein

said signal-to-noise ratio coefficient evaluation means comprises:

histogram evaluation means for obtaining the amplitude histogram from the intensity distribution of the optical signal within the mean time;

distribution function evaluation means for estimating an amplitude histogram distribution function g1 corresponding to "level 1" from an amplitude histogram portion that is greater than a predetermined intensity threshold value A, and for estimating an amplitude histogram distribution function g0 corresponding to "level 0" from an amplitude histogram portion that is smaller than another predetermined intensity threshold value B; and

optical signal quality evaluation means for obtaining mean value intensities and standard deviations of the "level 1" and "level 0" from the amplitude histogram distribution functions g1 and g0, and for evaluating the signal-to-noise ratio coefficient that is obtained as a ratio of a difference between the mean value intensities of the "level 1" and "level 0" to a sum of the standard deviations at the "level 1" and "level 0", and

wherein said optical wavelength division multiplexed signal monitoring apparatus carries out analog monitoring independent of an optical signal modulation method, format and bit rate.

40. (currently amended) The optical wavelength division multiplexed signal monitoring apparatus as claimed in any one of claims ~~5-37~~ 1-4 or 41-70, wherein said electric signal processing means is disposed in an optical signal receive terminal, and comprises:

a signal-to-noise ratio coefficient measuring section for measuring a signal-to-noise ratio coefficient of an optical signal transmitted on an optical signal route between an optical signal transmit terminal of a first optical node and an optical signal receive terminal of a second optical node;

an initial state storing section for storing an initial signal-to-noise ratio coefficient said signal-to-noise ratio coefficient measuring section measures in a state without any failure at a system installation; and

an optical signal quality evaluating section for comparing the initial signal-to-noise ratio coefficient stored in said initial state storing section with a signal-to-noise ratio coefficient said signal-to-noise ratio coefficient measuring section measures at every predetermined time interval during system operation, wherein

said signal-to-noise ratio coefficient measuring section comprises:

optical signal intensity distribution measurement means for measuring intensity distribution of the optical signal by sampling intensity of the electric intensity modulated

signal at a clock signal frequency f_1 (Hz) ($f_1 = (N/M)f_0 + a$, where N and M are positive numbers, and a is an offset frequency);

signal-to-noise ratio coefficient evaluation means for evaluating the signal-to-noise ratio coefficient using an amplitude histogram obtained from the optical signal intensity distribution within a mean time, and wherein

said signal-to-noise ratio coefficient evaluation means comprises:

histogram evaluation means for obtaining the amplitude histogram from the intensity distribution of the optical signal within the mean time;

distribution function evaluation means for estimating an amplitude histogram distribution function g1 corresponding to “level 1” from an amplitude histogram portion that is greater than a predetermined intensity threshold value A, and for estimating an amplitude histogram distribution function g0 corresponding to “level 0” from an amplitude histogram portion that is smaller than another predetermined intensity threshold value B; and

optical signal quality evaluation means for obtaining mean value intensities and standard deviations of the “level 1” and “level 0” from the amplitude histogram distribution functions g1 and g0, and for evaluating the signal-to-noise ratio coefficient that is obtained as a ratio of a difference between the mean value intensities of the “level 1” and “level 0” to a sum of the standard deviations at the “level 1” and “level 0”, and wherein

said distribution function evaluation means obtains two relative maximum values from the amplitude histogram obtained from the intensity distribution of the optical signal to be measured, and makes the relative maximum value with greater amplitude intensity

the intensity threshold value A, and the relative maximum value with smaller amplitude intensity the intensity threshold value B, and

wherein said optical wavelength division multiplexed signal monitoring apparatus carries out analog monitoring independent of an optical signal modulation method, format and bit rate.

41. (new) An optical wavelength division multiplexed signal monitoring apparatus comprising:

optical wavelength division demultiplexing means for carrying out optical wavelength division demultiplexing of an optical wavelength division multiplexed signal including N optical signals with a bit rate f_0 (bits/s), which are wavelength multiplexed, where N is an integer greater than one;

sampling clock generating means for generating a sampling clock signal whose repetition frequency is f_1 (Hz) ($f_1 = (n/m)f_0 + a$, where n and m are a natural number, and a is an offset frequency);

one or N optical gating means for sampling intensities of the optical wavelength division multiplexed signal or the optical wavelength division demultiplexed signals by using the sampling clock signal generated by said sampling clock generating means;

one or N opto-electric conversion means for receiving optical signals output by said optical gating means, and for converting the optical signals into said electric intensity modulated signals; and

electric signal processing means for carrying out optical signal quality evaluation based on the electric intensity modulated signals output from said one or N opto-electric conversion means,

wherein said electric signal processing means is a single system, and obtains optical signal intensity distribution from the electric intensity modulated signals output by said one or N opto-electric conversion means, and evaluates an optical signal quality parameter based on the optical signal intensity distribution.

42. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 41, wherein said electric signal processing means has N inputs, stores N channel electric signals supplied from said one or N opto-electric conversion means by N buffers for a predetermined time period, and processes the electric signals by sequentially reading them from said buffers.

43. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 41, wherein said electric signal processing means has N inputs, and processes N channel analog electric signals supplied from said one or N opto-electric conversion means by sequentially reading the analog electric signals by sequentially switching connections with the analog electric signals.

44. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 41, further comprising:

optical wavelength selection means for selecting and carrying out optical wavelength division demultiplexing of any one of channels of the optical wavelength division multiplexed signal consisting of N optical signals with a bit rate f_0 (bits/s), which are wavelength multiplexed, where N is an integer greater than one; and

selection wavelength control means for controlling a wavelength to be selected by said optical wavelength selection means,

wherein said single optical gating means is single, and samples one optical signal selected by said optical wavelength selection means under the control of said selection wavelength control means, and

said one or N opto-electric conversion means is a single opto-electric conversion means, and receives one-channel optical getting signal output by said optical gating means, and converts it into said electric intensity modulated signal.

45. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 41, further comprising:

optical wavelength selection means for selecting and carrying out optical wavelength division demultiplexing of any one of channels of N channel optical signal; and

selection wavelength control means for controlling a wavelength to be selected by said optical wavelength selection means,

wherein said optical gating means is single, and samples the optical wavelength division multiplexed signal all at once,

said optical wavelength selection means carries out optical wavelength selecting of the optical signals sampled by said optical gating means, and

said one or N opto-electric conversion means is a single opto-electric conversion means, and receives one-channel optical signal selected by said optical wavelength selection means, and converts it into said electric intensity modulated signal.

46. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 42, wherein

said optical gating means are N pieces, each of which is disposed for one of N channels, for sampling intensities of optical wavelength division demultiplexed signals with a bit rate of f_0 (bits/s), which are demultiplexed by said optical wavelength division demultiplexing means, by using the sampling clock signal generated by said sampling clock generating means, and

said one or N opto-electric conversion means receive optical signals sampled by said optical gating means disposed for respective channels, and convert the optical signals into said electric intensity modulated signals.

47. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 42, wherein

said optical gating means is single, and samples N channels of the optical wavelength division multiplexed signal all at once,

said optical wavelength division demultiplexing means carries out optical wavelength division of the optical signals sampled by said optical gating means, and

said one or N opto-electric conversion means consists of N opto-electric conversion means, and receives N-channel optical signals demultiplexed by said optical wavelength division demultiplexing means, and converts it into said electric intensity modulated signal.

48. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 43, wherein

said optical gating means are N pieces, each of which is disposed for one of N channels, for sampling intensities of optical wavelength division demultiplexed signals with a bit rate of f_0 (bits/s), which are demultiplexed by said optical wavelength division demultiplexing means, by using the sampling clock signal generated by said sampling clock generating means, and

said one or N opto-electric conversion means receive optical signals sampled by said optical gating means disposed for respective channels, and convert the optical signals into said electric intensity modulated signals.

49. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 43, wherein

said optical gating means is single, and samples N channels of the optical wavelength division multiplexed signal all at once,

said optical wavelength division demultiplexing means carries out optical wavelength division of the optical signals sampled by said optical gating means, and

said one or N opto-electric conversion means consists of N opto-electric conversion means, and receives N-channel optical signals demultiplexed by said optical wavelength division demultiplexing means, and converts it into said electric intensity modulated signal.

50. (new) An optical wavelength division multiplexed signal monitoring apparatus comprising:

optical wavelength division demultiplexing means for carrying out optical wavelength division demultiplexing of an optical wavelength division multiplexed signal including N optical signals with a bit rate f_0 (bits/s), which are wavelength multiplexed, where N is an integer greater than one;

optical sampling pulse train generating means for generating an optical sampling pulse train whose repetition frequency is f_1 (Hz) ($f_1 = (n/m)f_0 + a$, where n and m are a natural number, and a is an offset frequency) and whose pulse width is sufficiently narrower than a time slot of the optical signal with the bit rate f_0 (bits/s);

one or N combination of optical combining means and nonlinear optical media, the optical combining means for combining the optical wavelength division multiplexed signal or the optical wavelength division demultiplexed signal with the optical sampling pulse train, and the nonlinear optical media for inducing nonlinear interaction between the optical sampling pulse train and the optical wavelength division multiplexed signal or

the optical wavelength division demultiplexed singal combined by said optical combining means;

one or N opto-electric conversion means for receiving the cross-correlation optical signals generated by the nonlinear interaction in said nonlinear optical media, and for converting the cross-correlation optical signals into electric intensity modulated signals; and

electric signal processing means for carrying out optical signal quality evaluation based on the electric intensity modulated signals output from said one or N opto-electric conversion means,

wherein said electric signal processing means is a single system, and obtains optical signal intensity distribution from the electric intensity modulated signals output by said one or N opto-electric conversion means, and evaluates an optical signal quality parameter based on the optical signal intensity distribution.

51. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 50, wherein said electric signal processing means has N inputs, stores N channel electric signals supplied from said one or N opto-electric conversion means by N buffers for a predetermined time period, and processes the electric signals by sequentially reading them from said buffers.

52. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 50, wherein said electric signal processing means has N inputs, and processes N channel analog electric signals supplied from said one or N

opto-electric conversion means by sequentially reading the analog electric signals by sequentially switching connections with the analog electric signals.

53. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 50, further comprising:

optical wavelength selection means for selecting and carrying out optical wavelength division demultiplexing of any one of channels of the optical wavelength division multiplexed signal consisting of N optical signals with a bit rate f_0 (bits/s), which are wavelength multiplexed, where N is an integer greater than one;

selection wavelength control means for controlling a wavelength to be selected by said optical wavelength selection means; and

single optical splitting means, wherein

said combination of optical combining means and nonlinear optical media is single, and combines one channel optical signal selected by said optical wavelength selection means with said optical sampling pulse train to induce cross-correlation for both optical beams,

said optical splitting means splits a cross-correlation optical signal generated by the nonlinear interaction in said nonlinear optical medium form the optical wavelength selected signal and from the optical sampling pulse train, and

said one or N opto-electric conversion means is a single opto-electric conversion means, and receives said cross-correlation optical signal split by said optical splitting means, and converts it into said electric intensity modulated signal.

54. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 50, further comprising:

optical wavelength selection means for selecting any one of channels of N-channel optical signals; and

selection wavelength control means for controlling a wavelength to be selected by said optical wavelength selection means, wherein

said combination of optical combining means and nonlinear optical media is single, and combines said optical wavelength division multiplexed signal with said optical sampling pulse train to induce cross-correlation all at once,

said optical wavelength selection means selects any one of channels of N-channel cross-correlation optical signals generated by the nonlinear interaction in said nonlinear optical medium, and

said one or N opto-electric conversion means is a single opto-electric conversion means, and receives said cross-correlation optical signal selected by said optical wavelength selection means, and converts it into said electric intensity modulated signal.

55. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 51, further comprising:

optical sampling pulse train splitting means for splitting said optical sampling pulse train, wherein

said combination of optical combining means and nonlinear optical media are N set, and combines N-channel optical wavelength division demultiplexed signals with N

sequence optical sampling pulse trains splitted by said optical sampling pulse train splitting means to induce cross-correlation for both optical beams,

said optical splitting means splits cross-correlation optical signals generated by the nonlinear interaction in said nonlinear optical media from the optical wavelength division multiplexed signal and from the optical sampling pulse trains, and

said one or N opto-electric conversion means consists of N opto-electric conversion means for receiving said cross-correlation optical signal, and for converting it into said electric intensity modulated signal.

56. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 51, wherein

said combination of optical combining means and nonlinear optical media is single, and combines said optical wavelength division multiplexed signal with said optical sampling pulse train to induce cross-correlation all at once, and

said optical wavelength division demultiplexing means carries out wavelength division demultiplexing of a cross-correlation optical signal, which is generated by the nonlinear interaction in said nonlinear optical medium, into N channels, and

said one or N opto-electric conversion means consists of N opto-electric conversion means for receiving N-channel cross-correlation optical signal, and for converting it into N-channel electric intensity modulated signal.

57. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 52, further comprising:

optical sampling pulse train splitting means for splitting said optical sampling pulse train, wherein

said combination of optical combining means and nonlinear optical media are N set, and combines N-channel optical wavelength division demultiplexed signals with N sequence optical sampling pulse trains splitted by said optical sampling pulse train splitting means to induce cross-correlation for both optical beams,

said optical splitting means splits cross-correlation optical signals generated by the nonlinear interaction in said nonlinear optical media from the optical wavelength division multiplexed signal and from the optical sampling pulse trains, and

said one or N opto-electric conversion means consists of N opto-electric conversion means for receiving said cross-correlation optical signal, and for converting it into said electric intensity modulated signal.

58. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 52, wherein

said combination of optical combining means and nonlinear optical media is single, and combines said optical wavelength division multiplexed signal with said optical sampling pulse train to induce cross-correlation all at once, and

said optical wavelength division demultiplexing means carries out wavelength division demultiplexing of a cross-correlation optical signal, which is generated by the nonlinear interaction in said nonlinear optical medium, into N channels, and

said one or N opto-electric conversion means consists of N opto-electric conversion means for receiving N-channel cross-correlation optical signal, and for converting it into N-channel electric intensity modulated signal.

59. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 55, further comprising polarization control means for controlling a polarization state of all channels of the optical wavelength division multiplexed signal in their entirety, wherein said polarization control means controls the polarization state of all channels such that it maintains a fixed polarization relationship with a polarization state of the optical sampling pulse train said optical sampling pulse train generating means outputs.

60. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 56, further comprising polarization control means for controlling a polarization state of all channels of the optical wavelength division multiplexed signal in their entirety, wherein said polarization control means controls the polarization state of all channels such that it maintains a fixed polarization relationship with a polarization state of the optical sampling pulse train said optical sampling pulse train generating means outputs.

61. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 57, further comprising polarization control means for controlling a polarization state of all channels of the optical wavelength division

multiplexed signal in their entirety, wherein said polarization control means controls the polarization state of all channels such that it maintains a fixed polarization relationship with a polarization state of the optical sampling pulse train said optical sampling pulse train generating means outputs.

62. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 58, further comprising polarization control means for controlling a polarization state of all channels of the optical wavelength division multiplexed signal in their entirety, wherein said polarization control means controls the polarization state of all channels such that it maintains a fixed polarization relationship with a polarization state of the optical sampling pulse train said optical sampling pulse train generating means outputs.

63. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 53, further comprising polarization control means for controlling a polarization state of all channels of the optical wavelength division multiplexed signal in their entirety, wherein said polarization control means controls the polarization state of all channels such that it maintains a fixed polarization relationship with a polarization state of the optical sampling pulse train said optical sampling pulse train generating means outputs.

64. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 54, further comprising polarization control means for

controlling a polarization state of all channels of the optical wavelength division multiplexed signal in their entirety, wherein said polarization control means controls the polarization state of all channels such that it maintains a fixed polarization relationship with a polarization state of the optical sampling pulse train said optical sampling pulse train generating means outputs.

65. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 55, further comprising optical signal wavelength dispersion control means for controlling wavelength dispersion of the optical wavelength division multiplexed signal to compensate for wavelength dispersion of all channels of the optical wavelength division multiplexed signal in their entirety.

66. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 56, further comprising optical signal wavelength dispersion control means for controlling wavelength dispersion of the optical wavelength division multiplexed signal to compensate for wavelength dispersion of all channels of the optical wavelength division multiplexed signal in their entirety.

67. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 57, further comprising optical signal wavelength dispersion control means for controlling wavelength dispersion of the optical wavelength division multiplexed signal to compensate for wavelength dispersion of all channels of the optical wavelength division multiplexed signal in their entirety.

68. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 58, further comprising optical signal wavelength dispersion control means for controlling wavelength dispersion of the optical wavelength division multiplexed signal to compensate for wavelength dispersion of all channels of the optical wavelength division multiplexed signal in their entirety.

69. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 53, further comprising optical signal wavelength dispersion control means for controlling wavelength dispersion of the optical wavelength division multiplexed signal to compensate for wavelength dispersion of all channels of the optical wavelength division multiplexed signal in their entirety.

70. (new) The optical wavelength division multiplexed signal monitoring apparatus as claimed in claim 54, further comprising optical signal wavelength dispersion control means for controlling wavelength dispersion of the optical wavelength division multiplexed signal to compensate for wavelength dispersion of all channels of the optical wavelength division multiplexed signal in their entirety.